PATENT COOPERATION TREATY

10/049,756
5 6 10

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Commissioner
US Department of Commerce
United States Patent and Trademark Office, PCT
2011 South Clark Place Room CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 24 April 2002 (24.04.02)	
International application No. PCT/US01/19744	**Applicant's or agent's file reference** 26814/92555
International filing date (day/month/year) 19 June 2001 (19.06.01)	**Priority date** (day/month/year) 19 June 2000 (19.06.00)
Applicant STARKEY, Glenn	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

18 January 2002 (18.01.02)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer Ana MENA VALENCIA
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

HAMILL, Mark, A.
Barnes & Thornburg
2600 Chase Plaza
10 South LaSalle Street
Chicago, IL 60603
ETATS-UNIS D'AMERIQUE

Date of mailing (day/month/year)
21 January 2002 (21.01.02)

Applicant's or agent's file reference
26814/92555

IMPORTANT NOTIFICATION

International application No.
PCT/US01/19744

International filing date (day/month/year)
19 June 2001 (19.06.01)

1. The following indications appeared on record concerning:

☐ the applicant ☐ the inventor ☒ the agent ☐ the common representative

Name and Address

HAMILL, Mark, A.
Barnes & Thornburg
Suite 2600
10 South LaSalle Street
Chicago, IL 60603
United States of America

State of Nationality

State of Residence

Telephone No.
312 357 1313

Facsimile No.
312 759 5646

Teleprinter No.

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☐ the person ☐ the name ☒ the address ☐ the nationality ☐ the residence

Name and Address

HAMILL, Mark, A.
Barnes & Thornburg
2600 Chase Plaza
10 South LaSalle Street
Chicago, IL 60603
United States of America

State of Nationality

State of Residence

Telephone No.
312 357 1313

Facsimile No.
312 759 5646

Teleprinter No.

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

☒ the receiving Office
☐ the International Searching Authority
☐ the International Preliminary Examining Authority
☒ the designated Offices concerned
☐ the elected Offices concerned
☐ other:

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

Sylvaine DESCLOUX

Telephone No.: (41-22) 338.83.38

10/049756

(19) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
27 December 2001 (27.12.2001)

PCT

(10) International Publication Number
WO 01/098752 A3

(51) International Patent Classification[7]: G01N 17/02, 27/26

(21) International Application Number: PCT/US01/19784

(22) International Filing Date: 21 June 2001 (21.06.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data: 6355157
09/603,763 22 June 2000 (22.06.2000) US

(71) Applicant *(for all designated States except US)*: **UNITED STATES FILTER CORPORATION** [US/US]; Legal Department/IP Department, 40-004 Cook Street, Palm Desert, CA 92211 (US).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: **MARTIN, Roy** [US/US]; 1440 Palmer, Downers Grove, IL 60516 (US).

(74) Agent: **GANZI, Gary, C.**; United States Filter Corporation, 75 Technology Drive, Lowell, MA 01851 (US).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

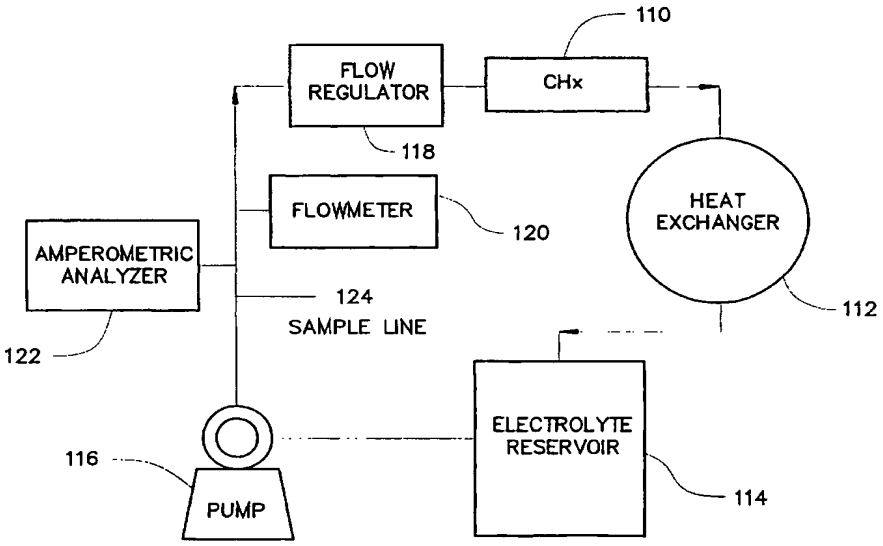
(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

(88) Date of publication of the international search report:
29 August 2002

[Continued on next page]

(54) Title: PROCESS FOR REAL-TIME DETECTION AND INHIBITION OF LOCALIZED CORROSION



(57) Abstract: This invention describes a novel means of determining the nature (type) of corrosion in real-time. By identifying localized corrosion at the moment of pit initiation, real-time selection, and effective concentration(s) of approriate inhibitor(s) can be delivered to an electrolytic solution before propagation of the localized corrosion. Integrating this information with a corrosion inhibitor feed system can effectively inhibit the corrosion before propagation occurs, thereby maintaining system integrity. The process embodies a method of operation wherein the electrochemical noise (ECN) and linear polarization (LPR) values are processed to compare how the corrosion signals correlate. Divergence of the corrosion rates indicates the formation of localized corrosion while continuity in signal pattern indicates generalized corrosion.

WO 01/098752 A3

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 01/19784

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G01N17/02 G01N27/26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 575 678 A (HLADKY KAREL) 11 March 1986 (1986-03-11) column 3, line 12 - line 44; figure 1 column 4, line 11 - line 61 column 5, line 18 - line 23 column 10, line 50 - line 68 ---	1-4
A	WO 00 34760 A (JOVANCICEVIC VLADIMIR ;BAKER HUGHES INC (US)) 15 June 2000 (2000-06-15) page 1, line 6 - line 10 page 5, line 28 -page 6, line 9 page 9, line 11 - line 16; figures --- -/--	1,3

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 June 2002	02/07/2002

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Savage, J

Form PCT/ISA/210 (second sheet) (July 1992)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	US 6 015 484 A (YAFFE MAX R ET AL) 18 January 2000 (2000-01-18) column 1, line 50 - line 66 column 3, line 60 - line 67 column 8, line 29 -column 9, line 21	1,3
A	GUSMANO ET AL.: "Electrochemical Noise Resistance as a Tool for Corrosion Rate Prediction" CORROSION, vol. 53, no. 11, 1997, pages 860-868, XP001073846 page 861, left-hand column, line 57 -right-hand column, line 56; figures 1,12,13 page 862, right-hand column, paragraph 2 -page 863, left-hand column, line 51 page 868, left-hand column	1,3
A	DEXTER ET AL.: "Use and Limitations of Electrochemical Techniques for Investigating Microbiological Corrosion" CORROSION, vol. 47, no. 4, 1991, pages 308-318, XP001073847 page 314, right-hand column, paragraph 3 -page 316, left-hand column, paragraph 1 page 317, right-hand column, paragraph 1	1,3
A	MANSFIELD AND SUN: "Localization Index Obtained from Electrochemical Noise Analysis" CORROSION, vol. 55, no. 10, 1999, pages 915-918, XP001073858 the whole document	1,3

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 01/19784

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4575678 A	11-03-1986	CA 1210066 A1	19-08-1986
		DE 3379978 D1	06-07-1989
		EP 0084404 A2	27-07-1983
WO 0034760 A	15-06-2000	AU 2478800 A	26-06-2000
		BR 9915977 A	11-09-2001
		CN 1338043 T	27-02-2002
		EP 1137926 A1	04-10-2001
		NO 20012499 A	02-08-2001
		WO 0034760 A1	15-06-2000
		US 6280603 B1	28-08-2001
US 6015484 A	18-01-2000	NONE	

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To: MARK A. HAMILL
BARNES & THORNBURG
10 SOUTH LASALLE STREET
SUITE 2600
CHICAGO, IL 60603

PCT

NOTIFICATION OF TRANSMITTAL OF INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Rule 71.1)

	Date of Mailing *(day/month/year)*
Applicant's or agent's file reference 26814-92555	IMPORTANT NOTIFICATION

International application No.	International filing date *(day/month/year)*	Priority Date *(day/month/year)*
PCT/US01/19744	19 JUNE 2001	19 JUNE 2000

Applicant
PROGRESSIVE COMPONENTS INTERNATIONAL CORPORATION

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices)(Article 39(1))(see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	Authorized officer TIM HEITBRINK
Facsimile No. (703) 305-3230	Telephone No. (703) 308-0651

Form PCT/IPEA/416 (July 1992)★

10/049756

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
26814-92555		
International application No.	International filing date (day/month/year)	Priority date (day/month/year)
PCT/US01/19744	19 JUNE 2001	19 JUNE 2000

International Patent Classification (IPC) or national classification and IPC
IPC(7): B29C 45/40 and US Cl.: 264/334,336; 425/436R,444,556

Applicant
PROGRESSIVE COMPONENTS INTERNATIONAL CORPORATION

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 3 sheets.

☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority. (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 0 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of report with regard to novelty, inventive step or industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
18 JANUARY 2002	18 APRIL 2002
Name and mailing address of the IPEA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	Authorized officer TIM HEITBRINK
Facsimile No. (703) 305-3230	Telephone No. (703) 308-0651

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/US01/19744

I. Basis of the report

1. With regard to the **elements** of the international application:*

[X] the international application as originally filed

[X] the description:
pages 1-15 , as originally filed
pages NONE , filed with the demand
pages NONE , filed with the letter of _____

[X] the claims:
pages 16-21 , as originally filed
pages NONE , as amended (together with any statement) under Article 19
pages NONE , filed with the demand
pages NONE , filed with the letter of _____

[X] the drawings:
pages 1-6 , as originally filed
pages NONE , filed with the demand
pages NONE , filed with the letter of _____

[X] the sequence listing part of the description:
pages NONE , as originally filed
pages NONE , filed with the demand
pages NONE , filed with the letter of _____

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language _____ which is:

[ ] the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).

[ ] the language of publication of the international application (under Rule 48.3(b)).

[ ] the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

[ ] contained in the international application in printed form.

[ ] filed together with the international application in computer readable form.

[ ] furnished subsequently to this Authority in written form.

[ ] furnished subsequently to this Authority in computer readable form.

[ ] The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

[ ] The statement that the information recorded in computer readable form is identical to the writen sequence listing has been furnished.

4. [X] The amendments have resulted in the cancellation of:

[X] the description, pages NONE

[X] the claims, Nos. NONE

[X] the drawings, sheets/~~fig~~ NONE

5. [ ] This report has been drawn as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed. as indicated in the Supplemental Box (Rule 70.2(c)).**

* *Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).*

***Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.*

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/US01/19744

II. Priority

1. ☐ This report has been established as if no priority had been claimed due to the failure to furnish within the prescribed time limit the requested:

   ☐ copy of the earlier application whose priority has been claimed.

   ☐ translation of the earlier application whose priority has been claimed.

2. ☐ This report has been established as if no priority had been claimed due to the fact that the priority claim has been found invalid.

Thus for the purposes of this report, the international filing date indicated above is considered to be the relevant date.

3. Additional observations, if necessary:

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non obvious), or to be industrially applicable have not been and will not be examined in respect of:

☐ the entire international application.

☐ claims Nos. _

because:

☐ the said international application, or the said claim Nos. _ relate to the following subject matter which does not require international preliminary examination *(specify)*.

☐ the description, claims or drawings *(indicate particular elements below)* or said claims Nos. _ are so unclear that no meaningful opinion could be formed *(specify)*.

☐ the claims, or said claims Nos. _ are so inadequately supported by the description that no meaningful opinion could be formed.

☐ no international search report has been established for said claims Nos. __.

2. A meaningful international preliminary examination cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

☐ the written form has not been furnished or does not comply with the standard.

☐ the computer readable form has not been furnished or does not comply with the standard.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/US01/19744

IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees the applicant has:

- ☐ restricted the claims.
- ☐ paid additional fees.
- ☐ paid additional fees under protest.
- ☐ neither restricted nor paid additional fees.

2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

- ☐ complied with.
- ☐ not complied with for the following reasons:

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

- ☐ all parts.
- ☐ the parts relating to claims Nos. _.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/US01/19744

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. statement

Novelty (N)	Claims	1-22	YES
	Claims	NONE	NO
Inventive Step (IS)	Claims	1-22	YES
	Claims	NONE	NO
Industrial Applicability (IA)	Claims	1-22	YES
	Claims	NONE	NO

2. citations and explanations (Rule 70.7)

Claims 1-22 meet the criteria set out in PCT Article 33(2)-(3), because the prior art does not teach or fairly suggest an ejector sleeve comprising a base portion, a tube portion and a lip for forming a portion of a raised aperture, a mounting plug having a head and tip portion, a base, a threaded exterior surface, a driving surface and a mold component as well as a method for mounting an injection mold component.

Claims 1-22 meet the criteria set out in PCT Article 33(4), because the claimed invention can be made or used in industry to provide a method and apparatus for ejecting an article.

---------- NEW CITATIONS ----------
NONE

VI. Certain documents cited

1. Certain published documents (Rule 70.10)

Application No. Patent No.	Publication Date (day/month/year)	Filing Date (day/month/year)	Priority date (valid claim) (day/month/year)

2. Non-written disclosures (Rule 70.9)

Kind of non-written disclosure	Date of non-written disclosure (day/month/year)	Date of written disclosure referring to non-written disclosure (day/month/year)

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

Supplemental Box
(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: Boxes I - VIII

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
27 December 2001 (27.12.2001)

PCT

(10) International Publication Number
WO 01/98056 A1

(51) International Patent Classification[7]: B29C 45/40

(21) International Application Number: PCT/US01/19744

(22) International Filing Date: 19 June 2001 (19.06.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/212,248 19 June 2000 (19.06.2000) US

(71) Applicant *(for all designated States except US)*: **PROGRESSIVE COMPONENTS INTERNATIONAL CORPORATION** [US/US]; 235 Industrial Drive, Wauconda, IL 60084 (US).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **STARKEY, Glenn** [US/US]; Progressive Components International Corporation, 235 Industrial Drive, Wauconda, IL 60084 (US).

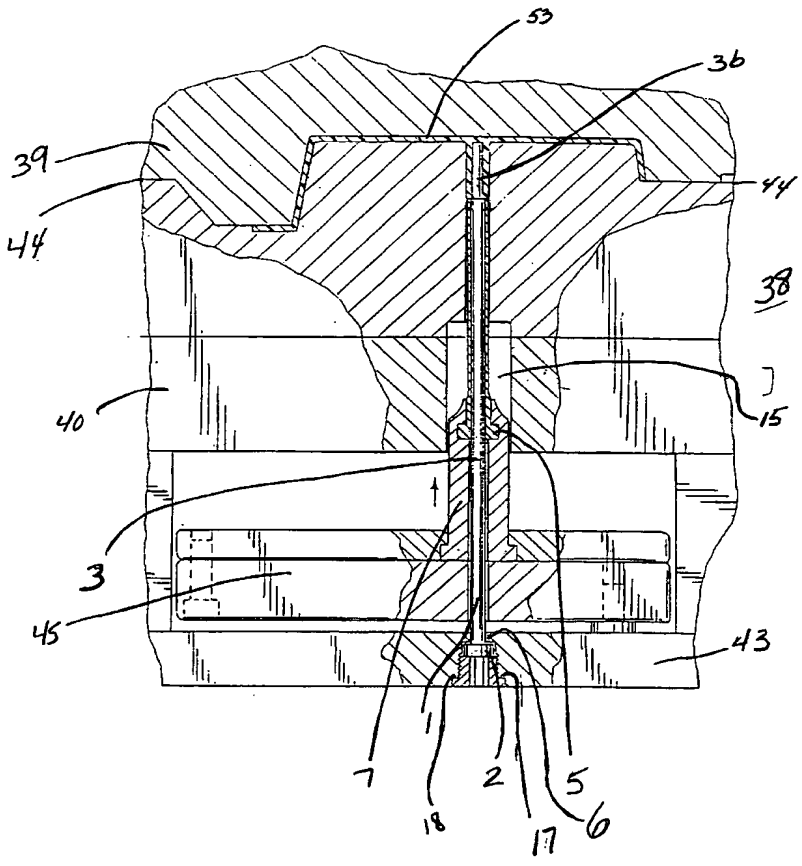
(74) Agents: **HAMILL, Mark, A.** et al.; Barnes & Thornburg, 2600 Chase Plaza, 10 South LaSalle Street, Chicago, IL 60603 (US).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian

[Continued on next page]

(54) Title: A CORE PIN AND SLEEVE AND METHOD OF USING SAME



(57) Abstract: The present invention includes an improved ejector sleeve (5) having thinner side-walls than prior sleeves. The sleeves generally include a ring (31) for mounting the sleeve, a central bore (42) for receiving a core pin (1), a tube portion extending from the ring to a tube end portion. The side-walls defining the tube end portion have a thickness of less than forty thousandths, and preferably thirty thousandths of an inch. Preferably, the coated ejector sleeve is provided in which a thin, lubricous coating of nickel, chromium or alloys of chromium or nickel is applied to at least a portion of the sleeve. The coating is applied in thickness of less than .0001 inch which improves the wear characteristics of the pins and sleeves as well as allowing the coated pins and sleeves to be stocked and used as nominal thickness parts.

WO 01/98056 A1

A CORE PIN AND SLEEVE AND METHOD OF USING SAME

FIELD OF THE INVENTION

The invention generally relates to injection mold core pins and sleeves, which are used to form cored holes in articles formed by injection molding. More particularly, the invention relates to a core pin system including an improved thin walled sleeve, which preferably is used with an improved core pin retainer.

BACKGROUND

In injection molding, upper and lower mold halves are brought together to define a mold cavity into which heated molten plastic is injected under pressure. The mold halves are typically vertically aligned with an upper mold portion termed the cavity half and a lower mold portion termed the core mold half. For forming holes or apertures through the top or bottom surfaces of molded pieces, coring elements, such core pins are frequently utilized. When a raised aperture having side walls extending from the surface of the molded part is desired, the core element is often provided with an associated ejector sleeve which assists in forming a lip of the raised aperture and in breaking the plastic part free from the coring element to eject the part as the mold is opened.

Core pins are long, thin, metallic or ceramic cylinders which have a base with a head and shoulder portion adapted to assist in retaining the pin in the mold section or press piece. The pin's tip, which extends into the mold cavity, may be machined to a smaller diameter which forms a shoulder and is typically drafted so that the pin is tapered at the end to assist in ejection. The sleeve is typically a hollow tube sized to fit over the pin which has a base portion having head and shoulder portions for retention in a counterbore formed in the ejector plate. Core pins are typically mounted in the core mold half. When mounted, the pin extends through an aperture formed in the mold half and into the mold cavity.

In forming a raised aperture, the interior surface or side walls of the aperture are defined by the surface of the core pin, the lip of the raised aperture is defined by the core pin ejector sleeve (hereinafter "sleeve") and optionally a machined shoulder on the core

pin, and the exterior surface of the side walls of the aperture are defined by the core mold half.

The diameter and shape of the interior of the raised aperture is determined by the mold's end user by machining the diameter and shape of the end of the core pin and thickness of the sleeve as desired to correspond to the raised aperture's intended purpose. For example, if the raised aperture is placed in the molded article in order to receive a 1/8th screw, the diameter of the pin must be approximately 1/8th, approximately cylindrical in shape and within acceptable tolerances. The width of the side walls of the raised aperture is determined by the width of the sleeve and the cross-sectional diameter of the shoulder aperture in the mold. The width of the walls of the hole formed in the molded article is set by the end user by considering a number of factors, including the strength and rigidity of the plastic used to form the article.

Given the long, slender shape of the pin and sleeve, the core pin and sleeve can become broken or bent during installation or during the molding cycle. This damage may occur when the sleeve or molded article catch upon the sides of the aperture or are not properly positioned when the mold is closed. When the pin or ejector sleeve are damaged, the mold may become jammed and the mold machine must be taken off-line, disassembled and repaired. At the very least, this repair requires that the broken core pin be replaced, while loose fragments of the broken pin and/or molded articles must be removed. These repairs increase the maintenance costs for the injection mold machine and cause the mold's end user to lose valuable production time.

Another problem with prior core pins and sleeves is that when the molded article is ejected from the mold, the walls of the hole formed in the article can suffer fracture or defect due to adhesion of uncured plastic to the mold, core pin or sleeve. This damage can be due to the side walls having insufficient time to cure or cool during the mold cycle. One way to reduce molding cycle time is to reduce the thickness of the side wall of the raised aperture. In hot plastic and thermosetting plastic mold injection, any increase in the amount of plastic used to form a raised aperture also increases the cooling/setting cycle time for the mold, wherein the plastic cools and hardens to gain sufficient rigidity to prevent fracture or deformation prior to ejection. The more material used, the longer it takes to cool sufficiently. Even a small increase in cycle time per piece can become a significant manufacturing cost when considering the number of

articles being produced. Thus, it is generally recognized as desirable to decrease the side wall thickness of a raised aperture. Decreasing the width of the walls in turn decreases the amount of plastic used to fill the mold cavity and form the raised aperture. Even if this amount is negligible when viewed on a per/piece or per hole amount, since the number of pieces produced by a given mold can range into millions, and since there are often multiple raised apertures formed per molded article any decrease in materials used can result in significant cost savings for the end user.

Standard sleeve thicknesses for stock sleeves have commonly ranged from about .046 to about .125 inch which can form a raised aperture with side-wall thickness ranges from .046 to .125 inches. The foregoing advantages have resulted in mold users seeking to use thinner sleeves to make raised apertures with the same internal diameter, but with thinner side walls. However, mold component manufacturers have been reluctant to provide thinner sleeves due to their perceived fragility, particularly when the end user wants a sleeve of considerable length, *e.g.*, a sleeve that is more than four inches long. In order to decrease the thickness of the side-wall of a raised aperture while maintaining the same dimension for its inner diameter, a thinner sleeve is required.

The fragility of current injection mold core pin and sleeves can be exacerbated by the manner in which the pin is mounted. In one common type of mount, a threaded retaining bolt is used to secure the pin base to a press piece of the core mold half. The core pin base typically includes a broadened head and shoulders. A threaded mounting aperture is formed in the press piece to receive the base of the pin and retaining bolt. The retaining bolt is threaded into the mounting aperture so that the shoulder on the base of the pin is held flush against the top surface of the mounting aperture. This results in the mounting shoulder of the core pin being held tight against the interior surface of the press piece. Such a rigid hold on the base of the pin does not allow for any movement of the pin or sleeve relative to the molded part which can cause the pin and/or sleeve to be damaged during ejection of the part.

To alleviate the problems with rigid mounting, a second type of mount for core elements has been used which employs a separate mounting plate. The separate mounting plate is held in place by a separate mounting screw or bolt. The plate holds the pin in place, but with head clearance between the pin head and the press piece which allows the core pin and sleeve to move or float in its mounting. Such movement helps prevent

damage to the pin and sleeve if the pin or sleeve should catch upon the molded part of a portion of the mold during travel. However, this type of plate mount suffers from several drawbacks. For example, a relatively large rectangular aperture is typically required to be machined or milled into the exterior surface of the press piece to accommodate the mounting plate. The aperture for retaining the core pin head also has to be machined into the mold, as does a separate mounting hole for the bolt or screw which holds the mounting plate in place. Finally, a hole must also be machined into the mounting plate itself to correspond to the hole in the mold where the screw or bolt joins the plate and mold. This process adds several additional machining steps to the design and manufacture of the injection mold thereby increasing the mold's production cost. Further, since useable space for fitting required components on a mold is usually limited, the floating mount plate is often viewed as an inefficient use of that available space on the mold.

Another problem with prior ejector sleeves was that they become worn quicker than is desirable by friction between the exterior surface of the sleeve and the mold base as well as between the interior surface of the sleeve and the exterior surface of the core pin. Thus, there is a need for a core pin and core pin sleeve which have improved wear characteristics.

Thus, there is a need for a more robust, thin walled sleeve which can be more easily installed and which can be used to form a thin walled raised apertures in injection molded articles thereby reducing cycle time and providing a savings on material costs.

SUMMARY OF THE INVENTION

The present invention includes an improved ejector sleeve having thinner side-walls than prior sleeves. The sleeves generally include a ring for mounting the sleeve, a central bore for receiving a core pin, a tube portion extending from the ring to a tube end portion. The side-walls defining the tube end portion have a thickness of less than forty thousandths, and preferably thirty thousandths of an inch. These thinner side-walls allow the end user to manufacture molded articles with raised apertures having the same interior diameter and thinner aperture side-walls. This results in decreased costs due to reduced mold cycle times as well as cost savings due to material reduction.

In one preferred aspect of the invention, a coated ejector sleeve is provided in which a thin, lubricous coating of nickel, chromium or alloys of chromium or nickel is applied to at least a portion of the sleeve. A similar coating is also preferably applied to the pin. The coating is applied in thickness of less than .0001 inch which improves the wear characteristics of the pins and sleeves as well as allowing the coated pins and sleeves to be stocked and used as nominal thickness parts. Such coated pins and sleeves have demonstrated improved wear resistance as well as lesser susceptibility to failure during operation in a mold.

In one embodiment of the invention, a sleeve extension is provided which has a base portion adapted to mount to an ejector plate. The sleeve extension preferably has a T-slot on the end opposite the base for receiving a mounting base of an ejection sleeve. The sleeve extension includes a through bore dimensioned to receive a core pin. The sleeve extension provides structural support for long, thin walled sleeves thereby allowing the use of longer stock ejector sleeves with decreased side-wall thickness.

In another embodiment of the invention, an improved core element mounting system is provided which allows for greatly simplified installation of a floating core mount. The mounting system of the invention provides sufficient head clearance that the core pin and sleeve adjust or deflect away from the sides of the mold without breaking. The system utilizes a novel plug which includes a threaded exterior surface, a plug shoulder for engaging a stop surface of a bore formed in the mold, a driving surface for engagement with a driving tool, and a head contacting surface for supporting the head of the core pin. The mounting system can be installed in a single aperture which can be machined in three steps. These steps may include machining a core element bore, machining wider bore which is dimensional to receive and engage the plug body and to have sufficient depth to accommodate the core pin head and provide head clearance, and machining a still wider bore which is dimensioned to receive the shoulders of the plug.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional view of the pin, ejector sleeve and sleeve extension assembled within a closed injection mold in accordance with one embodiment of the invention.

FIG. 2 is a cross-sectional view of the pin, sleeve and sleeve of FIG. 1 shown during the ejection cycle of the injection mold process with the mold halves partially opened.

FIG. 3 is an exploded view of the core ejector sleeve, the sleeve extension, ejector sleeve, and mounting plug of FIG. 1.

FIG 4. is a cross-sectional view of the mounting plug and core pin seated in a press piece in accordance with one embodiment of the invention.

FIG. 5 is an axial view of a ejector sleeve extension in accordance with one embodiment of the invention.

FIG. 6 is a cross-sectional view of the ejector sleeve extension of FIG. 5 taken along lines 6--6.

FIG. 7 is a cross-sectional view of the ejector sleeve extension taken along lines 7--7 of FIG. 5.

FIG 8. is a top axial view of the ejector sleeve in accordance with one embodiment of the invention.

FIG. 9 is a cross-sectional view of the core ejector sleeve taken along lines 9--9 of Figure 8.

FIG. 10 is a top axial view of the mounting plug in accordance with one embodiment of the invention.

FIG. 11 is a cross-sectional view of the mounting plug taken along lines 11--11 of FIG. 10.

FIG. 12 is a cross-sectional view of a prior art core pin mounting system.

FIG. 13 is a cross sectional view of another type of prior art core pin mounting system.

FIG. 14 is an enlarged cross-sectional view of the core pin tip, thin wall sleeve and molded article in accordance with one embodiment of the invention.

FIG. 15 is a cross-sectional view of the mold shown during opening of the mold to replace the worn ejector pins with an ejector pin mounted in the ejector plate using the novel mounting plug of one embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

The thin wall sleeves of one embodiment of the invention are shown mounted to an injection mold in FIGS. 1 and 2. As can be seen with referenced to these figures, core pin 1 extends through ejector plate 45, ejector sleeve extension 7 and ejector sleeve 5. The assembly of these pieces is best depicted in FIG. 3, which is an exploded view of these pieces. Ejector sleeve 5 is mounted through the T-slot 4 provided in the side of ejector sleeve extension 7. The core pin 1 is threaded through ejector sleeve extension 7 and ejector sleeve 5 and held in place by the mounting plug 9. As depicted in FIG. 3, the core pin 1 has a pin head 2, a shaft 3 having a first diameter and, as shown, may have a shaft end 3a which is machined by the end user to have a smaller diameter than the diameter of the shaft 3. The change in diameter between the pin head 2 and shaft end 3a forms a pin shoulder 22 around the exterior surface of the pin 1.

As can be seen in FIGS.1 and 2, the mold 38 including cavity half 39 and core half 40, a press piece 43a, an ejector plate 45, and the molded article 46. The mold halves 39 and 40 define a mold cavity 50 where they meet along part line 44. The molded article 46 is formed to have an aperture having an interior cavity 51 which is encompassed by a aperture wall 47, with the wall having an inner and outer circumference (not numbered) and lip 36.

As best seen in FIG. 9, the sleeve 5 has a lower mounting ring 31 and a hollow sleeve 37. The lower mounting ring 31, as can be seen in FIG. 3, is dimensioned to be slotted through T-slot 4 into the extension recess 33 in the ejector sleeve extension 7 to firmly nest within the ejector sleeve extension 7. Above the mounting ring 31 is a base portion 26 which has thicker side-walls than the sleeve end portion 24 to add to the strength of the sleeve. The sleeve 5 has a central bore 42 dimensioned to receive a core pin of a given diameter. The thickness (dimension 35 shown in FIG. 14) of the side-walls defining the sleeve end portion 24 ranges from about .020 to about .040, and preferably about .030 of an inch. In contrast, prior stock sleeves had side-wall thicknesses which ranged from about .046 to about .125 of an inch.

The sleeve extension 7 of one embodiment of the invention is shown in FIGS. 5, 6 and 7. As can be seen in FIG. 6, the ejector sleeve extension 7 has an extension shoulder 29 and a first bore 30 dimensioned to receive the shaft 3 of the core pin 1. The extension shoulder 29 is adapted to be received in an extension pocket 15 machined into the ejector plate 45 and core mold half 40. The first bore 30 is contiguous with the T-slot

4 which is dimensioned to receive the mounting ring 31 of the ejector sleeve extension 7. A second bore 32 is formed in the upper portion of the ejector sleeve extension 7 and is dimensioned to receive the base portion 26 of the ejector sleeve 5. FIG. 7 shows the ejector sleeve extension 7 in cross section and illustrates that the T-slot 4 extends through one exterior wall of the sleeve so that ejector sleeve 5 can be slid into place in the T-slot 4 and second bore 32 within the ejector sleeve extension 7. FIGS. 1 and 2 show the extension pocket 15 formed in the core mold half 40 and ejector plate 45 for receiving the sleeve extension 7, ejector sleeve 5, as well as the core pin 1. By use of the sleeve extension in embodiments of the invention illustrated in FIGS. 1, 2, 3, 6, 7 and 9, it has been found that very thin ejector sleeve having side wall thickness on the order of .030 of an inch may be used without excessive wear or damage to the sleeve, core pin or mold. Using such a sleeve extension, applicant has successfully tested and used sleeves and sleeve extension having a total height (dimension 34 in FIG. 2) in excess of 6 inches.

A single aperture 12 is machined by the end user having a first, second and third diameter to accommodate the core pin, sleeve, and mounting plug within the mold. The three aperture diameters are machined to closely match the two outside diameters of the mounting plug 9 and the outside diameter of the sleeve 5. The aperture 12 typically will be formed in three basic steps by machining three bores of differing diameter, a sleeve bore 14 dimensioned to receive the sleeve 5, a plug bore 13 dimensioned to receive a standard pin head 2 and plug body 27, and a plug shoulder bore 20 dimensioned to receive a plug shoulder 17. The core pin 1 extends through the core pin bore 14 in the mold section which is continuous with the single aperture 12, and the mounting plug 9 is threaded into the aperture 12. The plug 9 has a plug shoulder 17 formed between plug head 21 and threaded exterior cylindrical surface 16. The depth of the plug bore 13 is machined to slightly exceed the combined height of the plug 9 and pin head 2 as shown in dimension 28 on FIG. 4. When the mounting plug 9 is threaded flush into the plug bore 13 the plug head 21 contacts the stop surface 18 of the plug shoulder bore 20. The space left around the pin head 2 includes the head clearance 10, which will typically measure from about one to three thousandths of an inch. This head clearance 10 is sufficient to allow the core pin 1 to move forward and back, that is, float in the mount which can assist in preventing damage to the pin 1 and or sleeve 5 during installation and operation.

As seen in FIG. 1, the core pin 1 extends through the ejector plate 45 when assembled. Core pin 1 is passed through the sleeve extension 7 and ejector sleeve 5. The sleeve extension 7 is mounted in the ejector plate 45. The ejector sleeve 5, as can be seen best in FIG. 3, is mounted upon the ejector sleeve extension 7. The sleeve extension 7 provides structural support for the sleeve 5. It is contemplated that the core pins of the present invention may be used without the use of an extension. This would be particularly appropriate where the length of the sleeve is less than four inches. For applications with a relatively long ejection stroke, it is contemplated that a sleeve longer than four inches may be needed and a sleeve extension would commonly be used.

The mounting plug 9 of the present invention can be best seen in FIGS. 10 and 11. The body 27 of the mounting plug 9 has a threaded exterior cylindrical surface 16, and hexagonal recess 23. The plug body 27 extends to a plug head 21 with a larger diameter and a plug shoulder 17 which is adapted to engage the stop surface 18 of the plug shoulder bore 20. The top view of the retaining bolt, as seen in FIG. 10, shows the hexagonal recess 23 which is provided for tightening and loosening the retaining bolt with a hex-wrench tool, and a plug shoulder 17, which when mounting plug 9 is threaded into the aperture, is flush with the press piece 43a which houses the mounting plug depicted in FIG. 4. The aperture 12 is machined to have a stop surface 18 for engaging the plug shoulder 17 when the plug is threaded and fully tightened. The depth of the plug shoulder bore 20 and consequently the position of the stop surface 18 are correlated to the height of the plug shoulder 17 so that, when fully tightened down, the surface of head 21 is flush with the exterior of the mold.

In one embodiment of the invention, a novel mounting system is provided for securing core pins, coring members, and other mold components. This system is best understood with reference to the two types of prior mounting systems typically used which are shown in FIGS. 12 and 13. The first type seen in FIG. 13 has a threaded aperture 65 and a retaining bolt 63 which is threaded through the aperture to mount the core pin 67 tightly against the surface of the press piece 43c. The aperture 65 includes a stop surface 64 of lesser diameter which corresponds closely in diameter to the core pin. The shoulder 68 of the head 69 of the core pin 67 engages the stop surface 64 when the bolt 63 is tightened into the threaded aperture 65. This mechanism typically holds the pin 1 rigidly, which increases the likelihood that the long narrow pin will fracture or

break during installation or use. The bolt has a recess 66 for receipt of a hex-wrench or similar mechanism for tightening the bolt 63 in the threaded aperture 65.

The second type of mount seen typically used is shown in FIG. 12. This mounting system uses a mounting plate 55 held to the press piece 43b by a mounting screw 53 in a threaded aperture 60 that must be machined into the press piece 43b. The mounting plate 55 is placed into an aperture 59 machined into the press piece 43b. The aperture 59 for the mounting plate is typically large in comparison with the core pin 1 and core pin head 2 and is rectangular in shape as shown in FIG. 12. A head pin aperture 52 is formed in the press piece 43b for receiving the head 59 of the pin 57. The shoulder portion 58 of the pin 57 is not pressed flush against the stop surface 54 so that a head space 61 is created which allows a floating mount. Forming these multiple apertures in the press piece requires multiple machining steps and can require the use of multiple pieces of machining or drilling equipment. Moreover, the relatively large rectangular plate 55 takes up more space on the press piece than is desirable since such space is customarily at a premium. Again, the large number of steps increase the cost of manufacturing the mold.

The novel mounting system of this embodiment of the invention is shown in FIGS. 1-4. The mounting system provides head clearance 10 for a floating mount but can be installed in a greatly simplified procedure which requires a single aperture 12 having surfaces with a first, second and third diameter. The three diameters are machined to closely match the two diameters of the mounting plug 9 and the outside diameter of the sleeve 5. The aperture 12 is machined to have a plug bore 13 which has a threaded cylindrical surface 11 for receiving and engaging the threaded exterior surface 16 of the mounting plug 9. Mounting plug 9 has a plug body 27 which has a diameter similar to the diameter of the pin head 2. These two diameters correspond to the diameters to be drilled or machined into the mold section to form the plug bore 27 which received the plug to retain the pin head 2 of the core pin. The mounting plug has a plug shoulder 17 which has a larger diameter than the plug body 27. A plug shoulder bore 20 is machined into the press piece 43a which is dimensioned to receive the plug shoulder 17 in a flush mount relationship. It is contemplated that the novel core element mounting system shown in FIGS. 1-4 may be used to mount core elements other than core pins, such as, core blades as well as other mold components, *e.g.*, ejector blades or ejector pins.

In practice, core pins typically come in standard lengths and are machined and cut by the end user to correspond with the design for the mold itself. The pins have a pin head 2 which rests within and is engaged by the aperture 12 in the press piece 43. As depicted in FIG. 3, in this example, the end of the core pin 1 is machined by the end user to form a shaft shoulder 22 which correspond in part with the width of the walls of the raised aperture 48 to be formed in the molded article 46. In the embodiment depicted in FIG. 14, the width (dimension 49) of the walls 34 of the raised aperture 48 is approximately equal to the sum of the cross sectional, diameter (dimension 71) of the shoulder 22 and the width (dimension 35) of the hollow sleeve 37 of the ejector sleeve 5, as seen in FIG. 3. However, it is recognized that end users can also opt to select a thinner core pin, machine a smaller diameter cavity in the mold halves 39 and 40, and set the width (dimension 49) of the walls 34 of the raised aperture 48 and lip 36 as the width (dimension 35) of the ejector sleeve. Also, the end users often taper these parts, in particular to provide the pin with taper which is commonly referred to as draft, and machine a correspondingly shaped cavity into the mold sections, in place of the cylindrical cavities, and pins depicted herein.

In accord with the present invention, the width (dimension 49) of the walls 34 of the raised aperture 48 may be decreased to save on material costs as well as cycling time for the injection molding process. As best depicted in FIG. 2, these narrower walls correspond to the thinner ejector sleeve 5, whose walls 34 have a reduced thickness. Again, it is contemplated a thinner core pin 1 could be selected to thread through a narrower aperture in the mold halves 39 and 40, in machining a slightly longer shaft end 3a, leaving a narrower pin shoulder 22, or no pin shoulder at all. This would likewise have the effect of narrowing the walls 34 of the raised aperture 48 while maintaining the same size of the cavity 51 of the raised aperture 48.

During the injection mold process, after the mold sections and press piece are assembled, hot or thermosetting plastic is injected into the mold, the plastic cools or sets, and the piece is ejected. FIG. 1 depicts the assembled mold just after injection of hot or thermosetting plastic. FIG. 2 depicts the ejection of the molded article 46 just after the article has cooled or set.

As seen in FIG. 1, the molten plastic or thermosetting material which forms the molded article 46 has surrounded the pin tip 3 to fill in the cavity between the core pin

tip 3 and the mold half 40. This molten plastic or thermosetting material abuts the exterior lip 56 of the ejector sleeve end 24. When the shaft end 3a of the core pin 1 is machined to a smaller diameter as well, the material also abuts the shoulder 22 of the core pin 1. The pin head 2 rests within the head cavity 8 formed by the press piece 43 and the mounting plug 9. The head clearance 10, (FIG.4), allows the ejector sleeve 5 to travel through the mold half and 40 without deforming (not shown). The ejector plate 45 is adjacent to the press piece 43a, and the ejector sleeve 5 and ejector sleeve extension 7, which are correspondingly mounted on the ejector plate 45, follow core pin 1 along its length up to the machined shoulder 22 so that the lip 56 of the sleeve end 24, is adjacent to the core pin shoulder 22. The walls of the ejector sleeve 24 travel through the core mold half 40 and fill the cavity left between the core pin and the cavity in the mold half 40, to prevent molten material from flashing, *i.e.,* escaping around the edges of the ejector sleeve 5. In the exemplar ejection cycle depicted in FIG. 2, the ejector plate 45 has traveled upwardly to its full extent, the ejector sleeve is also extended upwardly, and the ejector sleeve 5 now extends past the part line 44 into the mold cavity 50. As can be best seen in FIG. 2, the aperture 51 formed in the now cured molded article 46 has walls 47 (after allowing for shrinkage) which have a width equal to the width of the ejector sleeve wall 24 and the core pin shoulder 22 combined.

To decrease cycling time by reducing the amount of hot molten material, and to save on material costs, the present invention also embodies an improved method of molding an article having a raised aperture 48 in the molded article 46. This method employs the step of first machining in an injection mold half as single aperture dimensioned to receive a mounting plug 9, ejector sleeve 5, and core pin 1. The core pin 1 is mounted to the press piece 43a of an injection mold by means of a mounting plug 9. The ejector sleeve is placed over the core pin 1 and mounted to the ejector plate 45. The injection mold is caused to move to a closed position and molten plastic is injected into the mold cavity such that the core pin, mold halves, and ejector sleeves form a molded article with a raised aperture. This method provided for a more durable ejector sleeve even when very thin sleeves are used. The ejector sleeve extension 7 may have thinner walls to correspond to a narrower gap between the shaft end 3 and the mold piece cavity 50. To prevent a thin sleeve extension piece from becoming damaged as it travels

through the mold, the pin may be mounted as seen in FIG. 4, to provide a head clearance 10.

In one preferred embodiment of the invention, the thin wall sleeve is coated with a uniform coating of a hard material such as chromium, nickel or alloys thereof having a very uniform thickness of between about .0001 and .00001 with no substantial build-up of the coating on the sharp edges or corners of the piece. The preferred ejector sleeves are made of A-2 steel with a surface hardness of 58-60RC and a surface finish of 4-10RMS. Preferably, the sleeve is treated with a uniform coating of an electroless nickel treatment sold under the tradename Nicklon® by Bales Mold Service, Inc., 2824 Hitchcock Avenue, Downers Grove, Illinois 60515. This surface coating provides excellent corrosion resistance and lubricating characteristics to the thin walled sleeves of the invention. The Nicklon® composition is believed to include 80-83% by weight nickel, 1-11% by weight phosphorus and 8-9 by weight polytetrofluourethylene. The co-efficient friction of the Nicklon® surface treating believed to be approximately 0.2 when analyzed using ASTM standard testing procedure D-2714. The Nicklon® coating is deposited on stock nominal length pins in a process which is proprietary to Bales Mold Service, Inc. that results in homogenous distribution of autocatalytic nickel and PTFE. The Nicklon® coating is designed to provide continual renewal of PTFE at the wear surface of the sleeve as the sleeve undergoes normal wear during use in an injection mold. The use of Nicklon® and other nickel-containing alloys over chromium alloys as indicated were superior corrosion resistance is desired. Several plastic resins used is the injection molding industry give off corrosive gases as they cure in the mold. The most commonly used of such resins in polyvinylchloride. The corrosive gases are known to react with chromium and chromium alloy coated surfaces in injection molds. Thus, for certain applications, chrome coated ejector sleeves are not desirable.

The thin wall sleeves of the present invention are typically manufactured and stocked in standard or nominal sizes such as 4 and 6 inches and are cut and deburred to size by the mold maker. With conventional sleeves, it has been standard practice for mold makers to cut and grind a sleeve to the desired size and then send the pin out for custom coating in small batches. This process was used since experience taught mold makers that surface coatings typically flaked or chipped during the cutting and deburring process. It has been found that the use of such very thin coating or chromium or nickel

on the thin wall sleeves of the present invention can survive the cutting and deburring process such that those sleeves can be pre-coated in large batches prior to cutting without any further need to coat or treat the sleeve afterward. This can yield a significant cost savings to the mold maker.

Optionally, the core pin for use with the sleeve may be coated with a nickel or chromium alloy coating. A particularly advantageous coating is sold by the tradename Nihard™ also by Bales Mold Service, Inc. The Nihard™ coating includes 48% by weight cobalt with the balance believed to be substantially nickel. The Nihard™ coating is pre-coated on standard core pins by a proprietary autocatalytic application process which does not require electroplating of the pins. Another advantage of the Nihard™ coating is that it is superior to chromium alloys for corrosion resistance as well as being substantially less costly than chromium-coated materials.

As shown in Figure 15 in a still further embodiment of the invention, the mold mounting plug 82 is used to provide a floating mount of an ejector pin 80 in the ejector plate 81. The method for installing the ejector pin in the ejector plate is substantially the same as explained above for mounting the core pin in the single aperture with first, second and third diameters. Likewise, the ejector plate and other mold plates are provided with a single continuous aperture with three diameters to mount and accommodate the ejector pin. The single aperture 86 is machined to form an ejector pin bore 92 having a first smaller diameter. The second diameter is machined to closely match the diameter of the mounting plug body 83 and the outside diameter of the head 85 of the ejector pin 80. The aperture 86 is machined to have a plug bore 84 which has a threaded surface 87 for receiving and engaging the exterior 89 of the mount plug 83. The single aperture 84 is machined to have a third, wider diameter bore 94 for accommodating the shoulders 96 of the mold plug 82. The ability to mount the core pin in the exterior surface 88 of the ejector plate 81 greatly simplifies removal and replacement of ejector pins that become either worn or damaged during use in the injection mold.

This process is accomplished by the operator jogging the mold into an open position in which the ejector pin is substantially extended into the mold cavity such that a space is provided between the exterior surface 88 of the ejector plate 81 and the mold base 93. This space allows the operator of the mold to easily replace ejector pins without

having to disassemble the mold to remove the pin plate 90 from the ejector plate 81 as is commonly done with conventional ejector pins. The ejector pin 80 is easily removed by insertion of a driving device into the driving surface of the hexagonal recess 91. The plug is rotated to loosen it and remove it from the ejector plate 81. The core pin 80 can be easily tapped from the open mold cavity to assist in removing it from the mold if it binds. In a similar manner, a replacement ejector pin can then be inserted into the single aperture until the ejector pin head is located within the ejector plate. The mounting plug is then inserted into the threaded bore and rotated by means of a suitable driving device in hexagonal recess until fully tightened.

The foregoing description and figures are intended as an illustration of the invention, and are not to be construed as containing or implying limitations upon the invention. It will be appreciated that although various aspects of the invention have been described with respect to specific embodiments, alternatives and modifications will be apparent from the present disclosure which are within the spirit and scope of the present invention as set forth in the following claims.

CLAIMS

What is Claimed:

1. An improved ejector sleeve for molding a raised aperture in a molded article formed within a mold having an ejector plate and a core pin, the ejector sleeve comprising:

a base portion located at a first end of the ejector sleeve for mounting the sleeve to the ejector plate of the mold;

a tube portion extending from the base to a second end of the ejector sleeve, the tube having and inner surface defining a central bore for receiving the core pin and an outer surface defining the exterior of the tube;

a lip located at a second end of the ejector sleeve for forming at least a portion of the raised aperture in the molded article; the width of the lip being defined as the distance between the inner surface and outer surface of the tube at the lip, the width of said lip being less than forty thousandths of an inch.

2. The improved ejector sleeve of Claim 1 wherein the width of the lip is further defined as the difference between the external diameter and internal diameter of the tube at the lip.

3. The improved ejector sleeve of Claim 1 wherein the width of the lip is less than thirty thousandths of an inch.

4. The improved ejector sleeve of Claim 1 wherein at least a portion of the surface of the sleeve is coated with a surface coating having a thickness of less than .0001 of an inch of a material selected from the group consisting nickel, chromium, alloys of nickel and alloys of chromium.

5. The improved ejector sleeve of Claim 1 wherein said coating is an alloy of nickel which further includes phosphorus and polytetrafluouroethylene.

6. An improved ejector sleeve and core pin system for molding a raised aperture in a molded article formed within a mold having an ejector plate, the system comprising;

(1) an ejector sleeve including, (a) a base portion located at a first end of the ejector sleeve for mounting the sleeve to the ejector plate of the mold, (b) a tube portion extending from the base to a second end of the ejector sleeve, the tube having and inner surface defining a central bore and an outer surface defining the exterior of the tube, and (c) a lip located at a second end of the ejector sleeve for forming at least a portion of the raised aperture in the molded article; the width of the lip being defined as the distance between the inner surface and outer surface of the tube at the lip, the width of said lip being less than forty thousandths of an inch;

(2) an core pin having a first end with a head adapted to be retained in a cavity formed in the mold base and a second end dimensioned for receipt within the central bore of the ejector sleeve and having a pin tip which defines at least a portion of the raised aperture when the mold is closed; and

(3) a plug having a base with (a) a shoulder for engaging a stop surface in an core pin aperture formed in the mold, (b) a threaded exterior surface for engaging a threaded surface in the aperture formed in the mold, (c) a driving surface for engagement with a rotating driving tool to tighten the mounting plug into position, and (d) a core pin contacting surface for supporting a surface of the core pin within the core pin aperture.

7. The system of Claim 6 further comprising a sleeve extension for receipt of the ejector sleeve having a first end and a second end, the first end of the sleeve extension having a base portion adapted to mount to an ejector plate, the second end of the sleeve extension having a slot for receiving the base of the ejector sleeve, and a tube portion extending between the base and slot and defining a through bore dimensioned to receive the core pin.

8. The system of Claim 6 wherein the width of the lip is further defined as the difference between the external diameter and internal diameter of the tube at the lip.

9. The system of Claim 6 wherein the width of the lip is less than thirty thousandths of an inch.

10. The system of Claim 6 wherein at least a portion of the surface of the sleeve is coated with a coating having a thickness of less than .001 of an inch of a metal compound selected from the group consisting nickel, chromium, alloys of nickel and alloys of chromium.

11. A mounting plug for mounting an injection mold component having a head portion and tip portion within an aperture in a mold, the mounting plug comprising:

a base having a shoulder for engaging a stop surface of the aperture formed in the mold;

a threaded exterior surface for engaging a threaded surface in the aperture formed in the mold;

a driving surface adapted to engage a rotating driving tool to tighten the mounting plug into position; and

a mold component contacting surface to support the head portion of the mold component within the aperture.

12. The mounting plug of claim 11 wherein said mold component is a core pin and wherein the mold component contacting surface is dimensioned to support the head portion of the core pin.

13. The mounting plug of claim 12 wherein the tip portion of the core pin is adapted to be inserted within an ejector sleeve for forming a raised aperture in the surface of a molded article.

14. The mounting plug of claim 11 wherein the mold component is an ejector pin, the contacting surface is adapted to support an ejector pin, and the stop surface of the aperture is formed in the ejection plate of the mold.

15. The mounting plug of claim 11 wherein the mold component contacting surface is adapted to support a sucker pin.

16. A method for mounting an injection mold component having a tip, shoulder, and head portion in a single aperture formed in the mold, the method comprising the steps of:

machining a first portion of the single aperture with an internal diameter dimensioned to receive the tip of the mold component;

machining a second portion of the single aperture with an internal diameter dimensioned to receive a plug body and dimensioned to receive the head portion of the mold component with some clearance to allow a floating mount, the second portion being machined to a depth slightly exceeding the height of the plug, the step formed at the transition between the first portion and second portion forming a mold component shoulder retaining surface;

machining a third portion of the single aperture with an internal diameter dimensioned to receive the shoulder portion of the mounting plug at a depth closing matching the height of the shoulder, the step formed at the transition between the between the second portion and third portion of the single aperture forming a stop surface in the mold for contacting the shoulder portion of the mold plug;

machining a thread into the second portion of the single aperture dimensioned to receive a threaded portion of the mounting plug;

placing the mold component within the single aperture such that the head of the mold component is retained within the second portion of the single aperture; and

rotating the mounting plug into position such that the shoulder is retained by the stop surface of the single aperture and such that sufficient clearance is provided around the head to create a floating mount of the mold component.

17. The method of Claim 16 wherein the mold component is a core pin with accompanying ejector sleeve and wherein the method further comprises the steps of:

machining a slot in one of the ejector plate or pin plate for retaining the sleeve base;

inserting the sleeve base in the slot; and

inserting the core pin in the ejector sleeve.

18. The method of Claim 16 wherein the mold component is a sucker pin.

19. The method of Claim 16 wherein the mold component is an ejector pin and the second portion of the single aperture is formed in one of the ejector plate and the pin plate.

20. The method of Claim 19 wherein the third aperture portion is formed in the exterior surface of an ejector plate and wherein the method further comprises the steps of:

installing the mold into a mold press;

running the mold press until replacement of the pin becomes necessary;

jogging the mold press into a position where the exterior surface of the ejector plate is accessible without disassembly of the mold;

removing the ejector pin by counter-rotating the plug;

inserting a second ejector pin of similar dimensions in the single aperture; and

rotating the plug into position such that a head of such ejector pin is retained within the single aperture by a floating mount.

21. A sleeve extension for receipt of the an ejector sleeve comprising:

a base located on a first end of the sleeve extension and being adapted to mount to a slot formed in one of an ejector plate or pin plate;

a slot located on a second end of the sleeve extension for receiving a base portion of an ejector sleeve; and

a tube portion extending between the base and slot and defining a through bore dimensioned to receive the ejector sleeve and a core pin.

22. An injection mold having an improved ejector pin retaining system comprising:

a first mold portion having surfaces defining a portion of a mold cavity;

a second mold portion having surfaces defining a portion of a mold cavity, the first and second mold portions being moveable between an opened position to eject a molded article and a closed position to mold the plastic article;

an ejector plate located within one of the first and second mold portions for providing reciprocal motion in a direction opposite to the movement of the first and second mold portions, the ejector plate having an aperture formed in an exterior surface, the aperture having a stop surface, and an interior threaded portion formed therein;

an ejector pin having a first end with a head adapted to be retained in an aperture formed in an exterior surface of the ejector plate and a second end including a molded article contacting surface, the article contacting surface contacts a portion of the molded article when the mold opens to assist in ejection of the molded article from the mold; and

a retaining plug for providing a floating mount including, (a) a base with a shoulder for engaging the stop surface within the aperture in the ejector plate, (b) a threaded exterior surface for engaging the threaded interior surface within the aperture formed in the ejector plate, (c) a driving surface for engagement with a rotating driving tool to tighten the mounting plug into position, and (d) an ejector pin contacting surface for supporting the surface of the ejector pin within the aperture in the ejector plate.

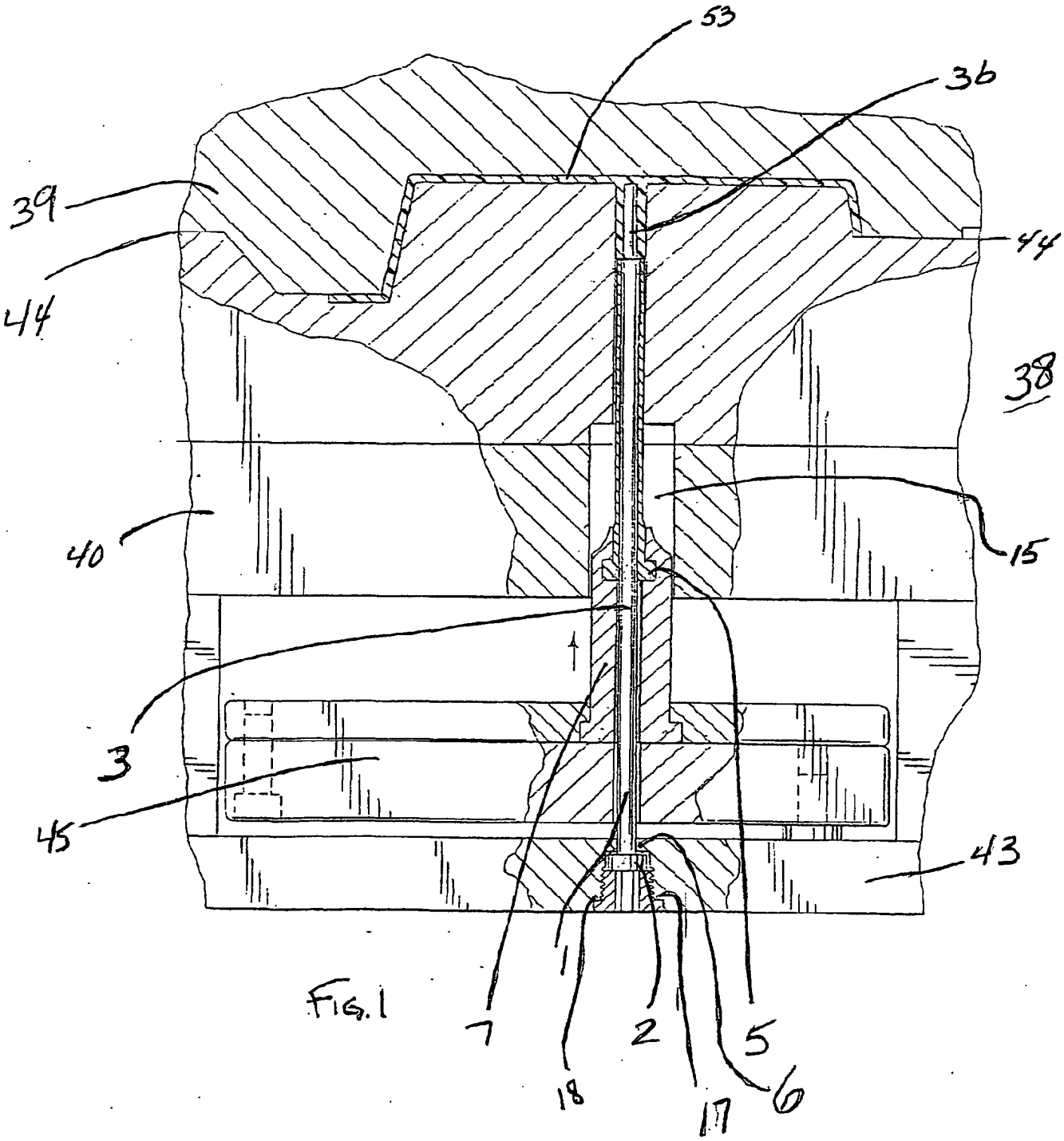
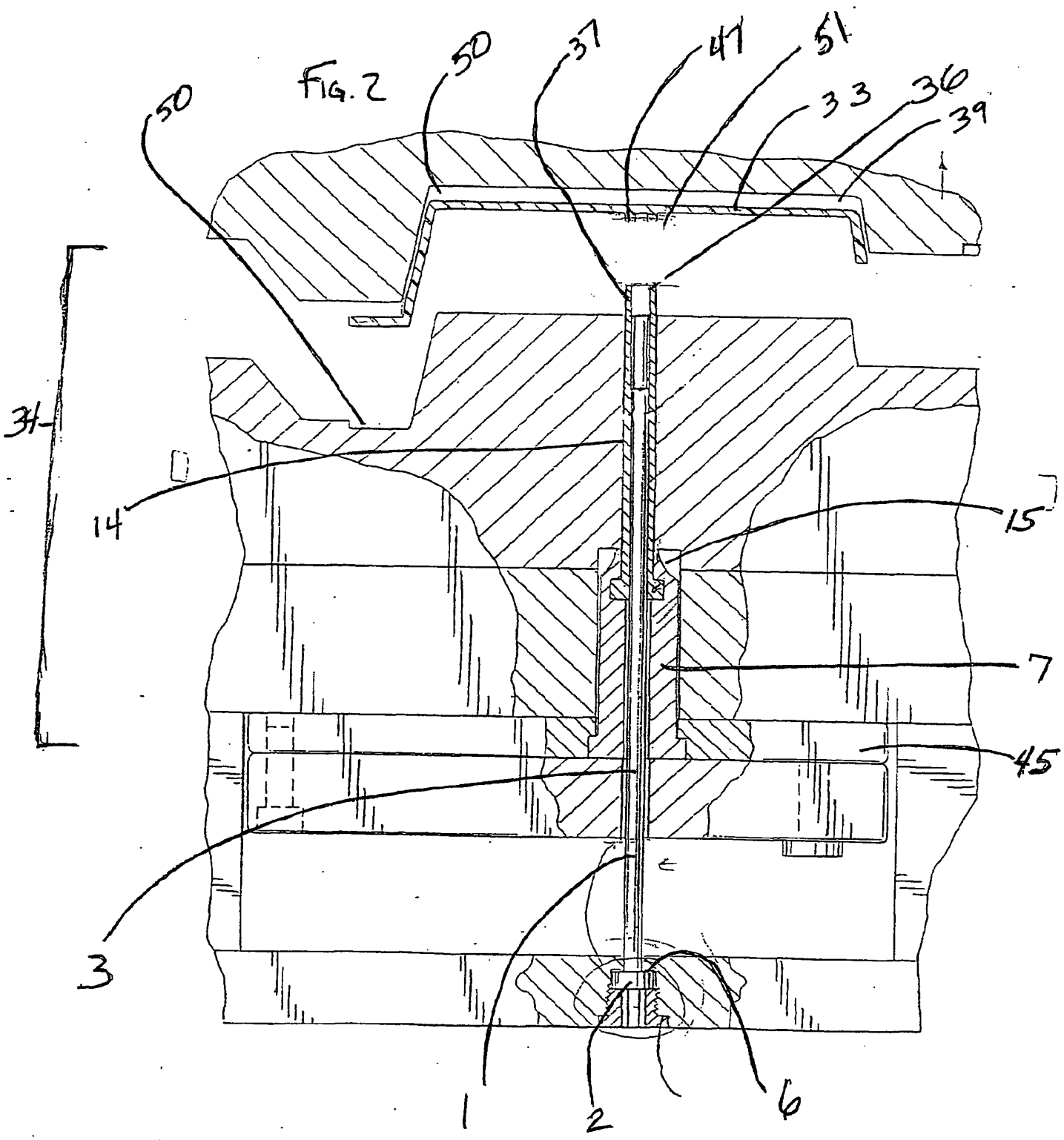


Fig. 1

FIG. 2



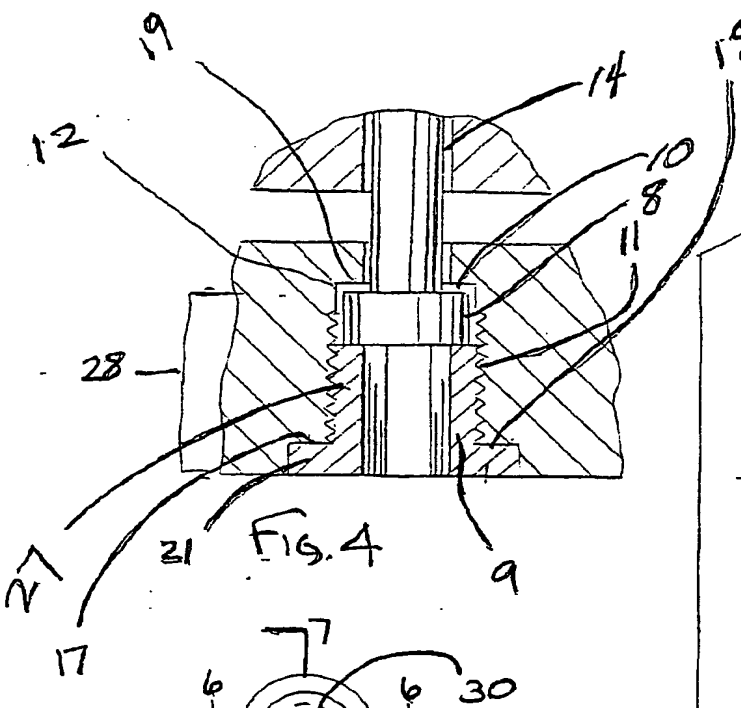


FIG. 4

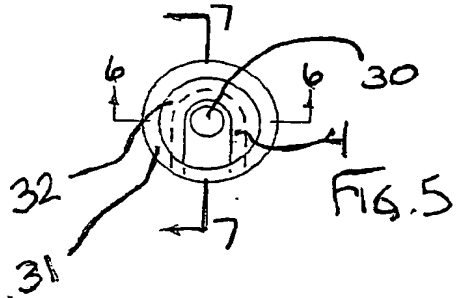


FIG. 5

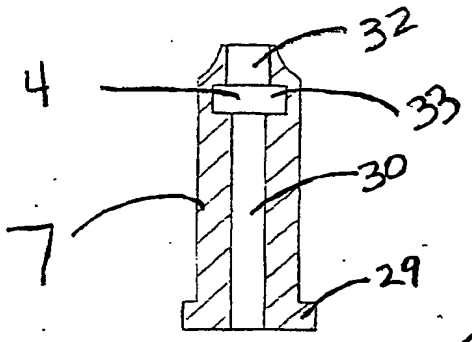


FIG. 6

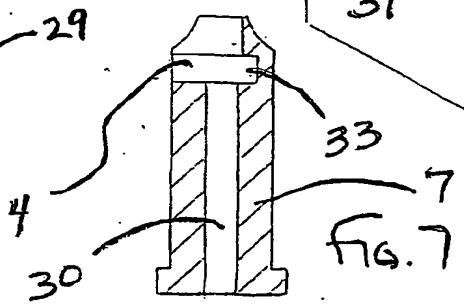
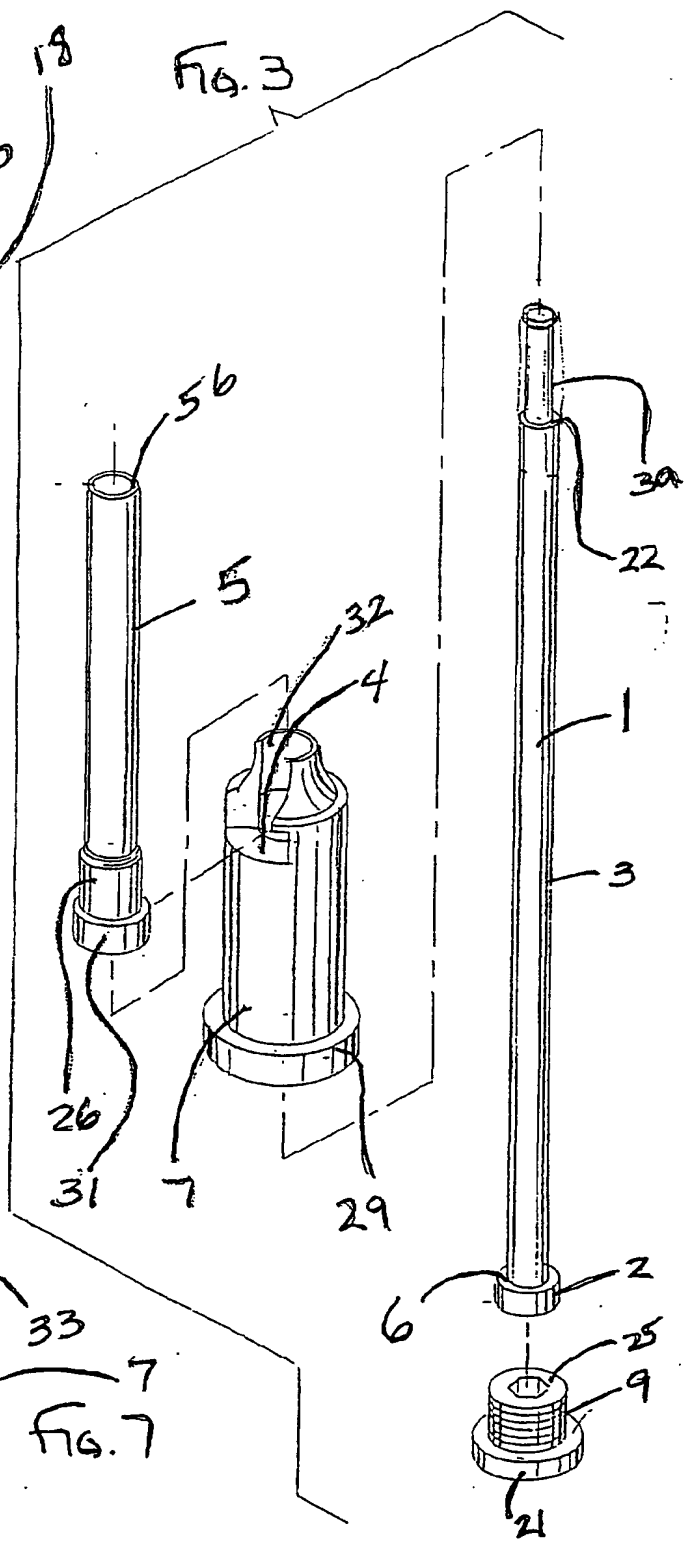


FIG. 7

FIG. 3



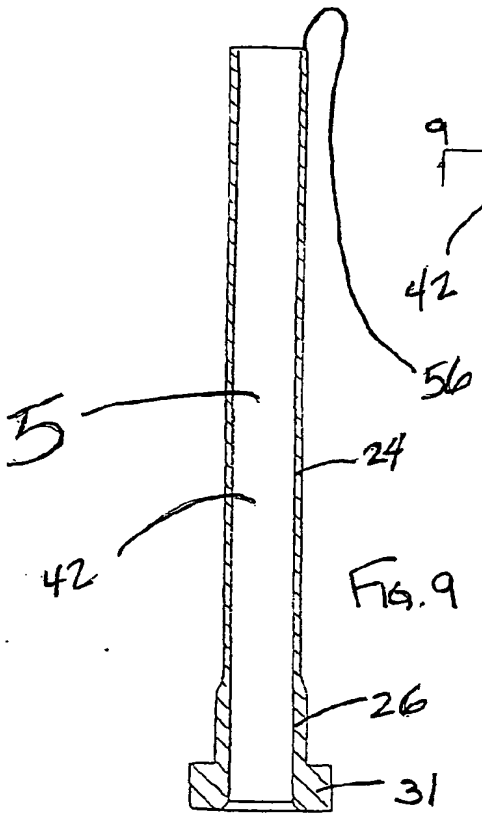


FIG. 9

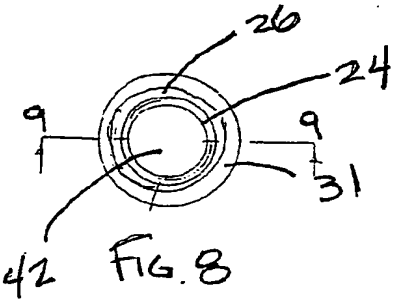


FIG. 8

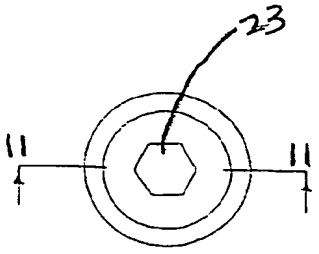


FIG. 10

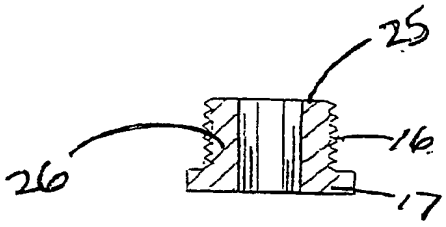


FIG. 11

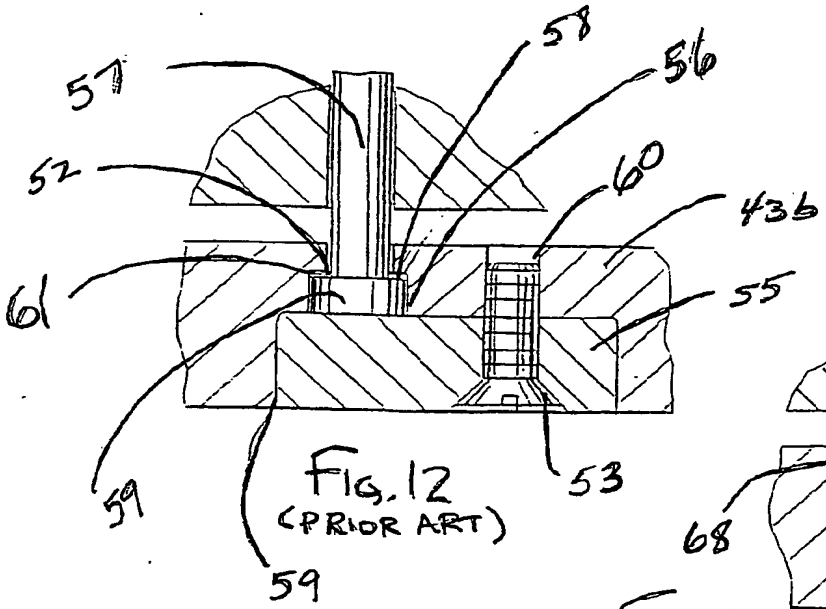


FIG. 12
(PRIOR ART)

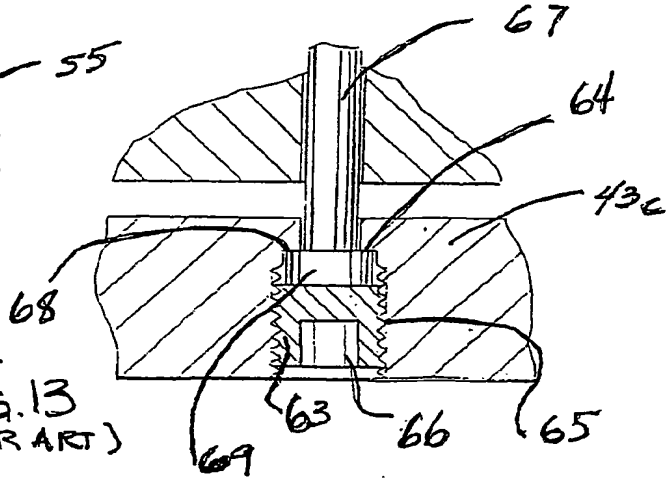


FIG. 13
(PRIOR ART)

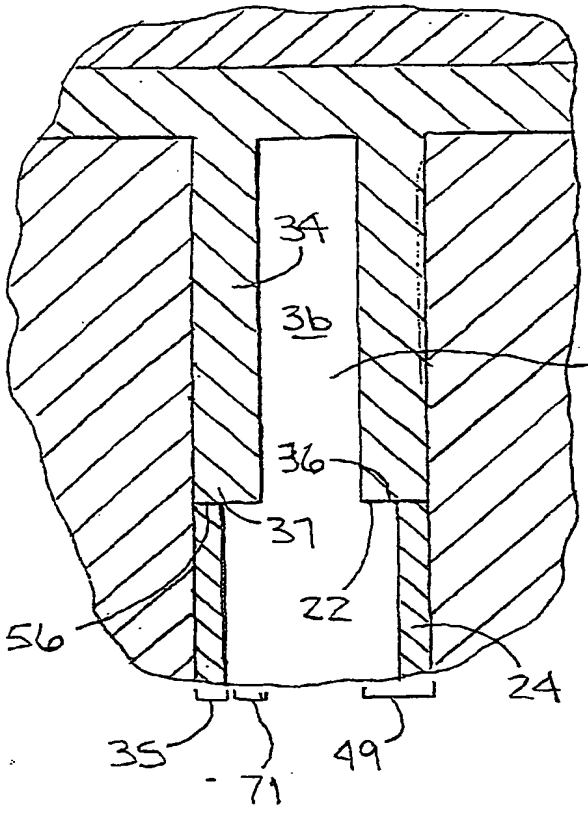


FIG. 14

FIG. 15